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# Antemortem Records of Forensic Significance Among Edentulous Individuals

**ABSTRACT:** The identification of edentulous individuals is problematic due to poor provision of labelled dental prostheses. Dental records may still provide useful information for odontologists in the comparative identification process. The purpose of this study was to determine the level of forensically significant information contained within the dental records of a population of denture wearers attending the University of Manchester School of Dentistry. Two hundred and two dental records were examined and a proforma completed. The mean age of the patients was 72 years. Medical history were absent in 4% of all records and only 67.8% of the written records were rated as good. Thirty-two percent of the records contained one or more panoramic radiographs but 30% of these were over 3 years old rendering their usefulness in identification procedures questionable. In total only 18% of the examined records contained antemortem information that would enable identification. These data suggest that the process of denture marking is an essential in order to ensure that the identification of this population can be undertaken expediently by dental means.

**KEYWORDS:** forensic science, dentures, identification, patient records, denture marking, denture labeling

Dental identification is one of the commonest means of identifying individuals who cannot be visually recognized (1). This is occurs in circumstances of gross decomposition, fire, trauma, and drowning. Dental identifications are therefore frequently employed in incidents involving mass fatalities (2). Dental identifications are predicated on the individuality of the human dentition and the increase in unique features that dental treatments render (2). However, dental identifications are still usefully used in individuals without restorations where a range of other features can be determined; many of them radiographically (3) (see Table 1). However, edentulous individuals pose a particular problem for forensic dentists. While the presence of unrestored teeth can offer a range of features, edentulous individuals possess very few of these. Indeed, the alveolar bone resorption and subsequent atrophy of both the maxilla but particularly the mandible often destroys what little unique features exist (4). In the U.K. last year (2005) over 300,000 individuals were rendered edentulous for the first time and therefore, despite an increase in the number of individuals who retain a functional dentition until death, the denture wearing population is still a sizable, and therefore important, group for forensic dentists to consider (5).

Dental records of edentulous individuals are often sparse, further complicating the identification effort. Patients wearing complete dentures will visit their dentists infrequently and require fewer special tests or examinations that would typically form the antemortem dental record. Radiographs are of particular importance in dental identifications yet they are rarely undertaken for individuals without teeth and whom require little in the way of preprosthetic surgery (6). Even in those cases where radiographs exist they are often of the pre-edentulous phase of the patient (see Fig. 1). Radiographs of edentulous mouths can be complex to use in identifications as, due to the aforementioned resorption, the appearance of the bony structures of the jaws is often significantly changed over time (6). This, coupled with the infrequent dental attendance of denture wearers can often confound efforts at dental identifications of this population.

The provision of some form of denture labeling is an obvious solution to these problems, but their use is minimal and there is no recommendation from the forensic societies as to the best method to employ (see Fig. 2). A further group of edentulous patients to consider are those who have been orally rehabilitated using dental implants; often to secure poorly functioning mandibular dentures. Such individuals will often have copious dental records, radiographs, and unique features which will enable them to be identified (7).

The purpose of the current study was to examine the dental records of edentulous patients in order to determine if they contained materials that were of forensic value should they require dental identifications. The hypothesis of this work was that such dental records would provide little in the way of quality antemortem materials that could be used in forensic determinations of identity.

## Methods and Materials

Ethical approval for this study was obtained from the Central Manchester Local Ethics Committee (Ref: CMMC/05/36528). Two hundred patients who had attended the School of Dentistry at Manchester, U.K. for the provision of complete (mandibular and maxillary) were randomly selected using the school's patient administration system. Each of the records were located and examined by a single individual who completed a proforma for each patient. The following information was collected from each record.

(a) Patient demographics.
(b) Treatment provided.
(c) Whether or not a laboratory box number was present in the notes (i.e., could the original dental casts from which the denture was fabricated be retrieved).

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TABLE 1—*Features examined during the comparative dental identification. This extensive list represents the complexity of these cases, particularly in those instances in which restorative treatment is absent or minimal. From Pretty et al. 2001.*

*Teeth*
Teeth present
- a. Erupted
- b. Unerupted
- c. Impacted

Missing teeth
- a. Congenitally
- b. Lost antemortem
- c. Lost postmortem

Tooth type
- a. Permanent
- b. Deciduous
- c. Mixed
- d. Retained primary
- e. Supernumerary

Tooth position
- a. Malpositions

Crown morphology
- a. Size and shape
- b. Enamel thickness
- c. Contact points
- d. Racial variations

Crown pathology
- a. Caries
- b. Attrition, abrasion, erosion
- c. Atypical variations, enamel pearls, peg laterals, etc.
- d. Dentigerous cyst

Root morphology
- a. Size
- b. Shape
- c. Number
- d. Divergence of roots

Root morphology
- a. Dilaceration
- b. Root fracture
- c. Hypercementosis
- d. Root resorption
- e. Root hemisections

Pulp Chamber/Root Canal morphology
- a. Size, shape and number
- b. Secondary dentine

Pulp Chamber/root canal pathology
- a. Pulp stones, dystrophic calcification
- c. Root canal therapy
- d. Retrfills
- e. Apicectomy

Periapical Pathology
- a. Abscess, granuloma or cysts
- b. Cementomas
- c. Condensing osteitits

Dental restorations
1. Metallic
   - a. Non-full coverage
   - b. Full coverage
2. Non-Metallic
   - a. Non-full coverage
   - b. Laminates
   - c. Full Coverage
3. Dental implants
4. Bridges
5. Partial and full removable prosthesis

*Periodontal tissues*
Gingival morphology and pathology
- a. Contour, recession, focal/diffuse, enlargements, interproximal craters
- b. Color — inflammatory changes, physiological (racial) or pathological pigmentations
- c. Plaque and calculus deposits

Periodontal ligament morphology and pathology
- a. Thickness
- b. Widening
- c. Lateral periodontal cysts and similar

Alveolar process and lamina dura
- a. Height, contour, density of crestal bone
- b. Thickness of interradicular bone
- c. Exostoses, tori
- d. Pattern of lamina dura
- e. Bone loss (horizontal/vertical)
- f. Trabecular bone pattern and boney islands
- g. Residual root fragments

*Anatomical features*
Maxillary sinus
- a. Size, shape, cysts
- b. Foreign bodies, fistula
- c. Relationship to teeth

Anterior nasal spine
- a. Incisive canal (size, shape, cyst)
- b. Median palatal suture

Mandibular canal
- a. Mental foramen
- b. Diameter, anomalous
- c. Relationship to adjacent structures

Coronoid and condylar processes
- a. Size and shape
- b. Pathology

Temperomandibular joint
- a. Size, shape
- b. Hypertrophy/atrophy
- c. Ankylosis, fracture
- d. Arthritic changes

Other pathologies
- a. Developmental cysts
- b. Salivary gland pathology
- c. Reactive/neoplastic
- d. Metabolic bone disease
- e. Focal or diffuse radiopacities
- f. Evidence of surgery
- g. Trauma — wires, surgical pins, etc.

(d) The quality of the written notes describing the treatment provided.
(e) The presence of any photographs, radiographs (type and age) and any other scans or special imaging investigations.
(f) Presence, type, and number of implants placed.
(g) Medical history form completed (these often contain information on other prostheses or surgical treatments that may assist in identification).

Following these assessments the investigator was asked to determine if there were sufficient antemortem records to permit an accurate postmortem identification.

g) Data were exported into SPSS (version 11, SPSS Inc., Chicago, IL) and frequency distributions were applied in order to determine the incidence of features within the population examined.

## Results

In total 202 dental records were examined. The mean age of the patients was 72 ( $\pm$ 12) years and 65% were female. Medical history forms were absent in 4% of the records, incomplete in 8.9%, poorly completed in 32.1% and complete in 55%. In all 200 records only one photograph was found and there were no CT, MRI, or other scans present. A laboratory box identifier was found in 30.2% of the records.

An assessment of the written notes found that 4% could be rated as poor (containing little or no information on the treatment conducted), 28.2% were satisfactory and 67.8% were rated as good.

67.8% of the records examined contained no radiographs. Thirty-two percent had one or more dental panoramic tomographs (DPTs) and 5% had one or more lateral skull views, some of which had been acquired cephalometrically. Thirty percent of the radiographs were older than 3 years at the time of examination.

2.3% of the patients had been treated with implants. The number placed per patient ranged from 2 to a maximum of 10 and the commonest system was Astra. All of the records relating to patients with implants had complete documentation including details of the implant type, size and batch number (see Fig. 3).

Only 38 (18%) of the 202 records examined were considered by the examiner to contain dental antemortem records of sufficient quality to permit an odontological comparison for the purposes of

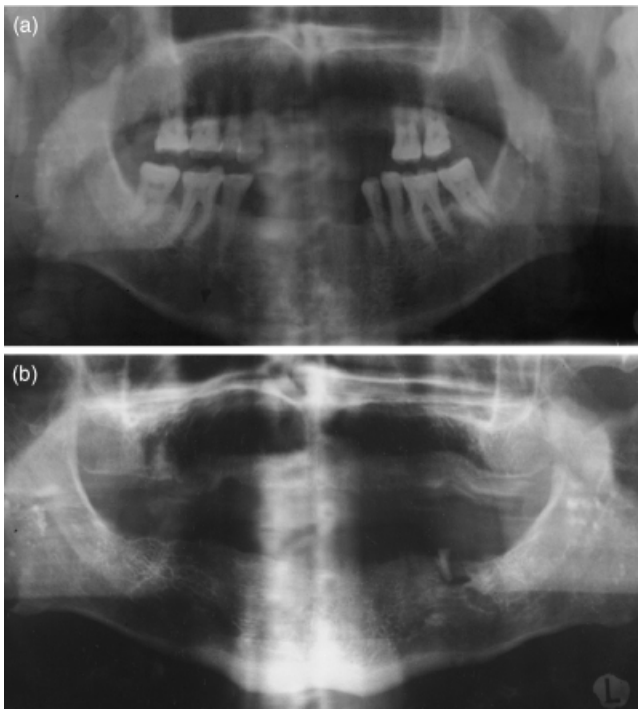


FIG. 1—*Example of dental panoramic tomography radiographs within a patient record. (a) Radiograph taken in 1990 to assess periodontal bone loss. (b) Same patient radiographed in 1993 following loss of all but a small root fragment on the patient's left side.*

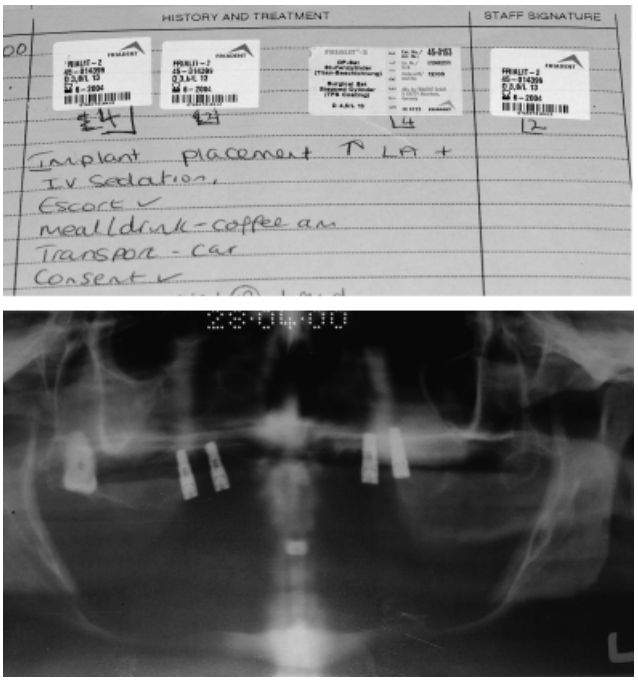


FIG. 3—*Example of a patient's record detailing implant placement, the batch numbers of the implants placed and an accompanying radiograph of the postplacement maxilla. Note the lack of features in the atrophic mandible.*

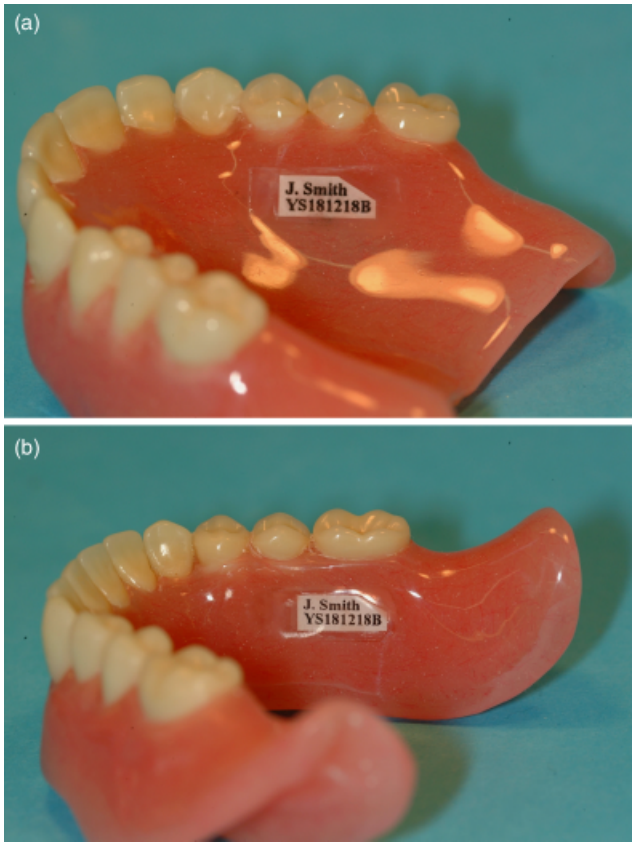


FIG. 2—*Example of a simple denture labeling system on (a) the maxillary denture; (b) the mandibular denture.*

identification. Three individuals had other features described within the records that could permit identification; i.e., pacemakers and orthopaedic prostheses.

None of the patient records examined contained any details of denture labeling procedures.

## Discussion

Only 18% of the individuals represented by the records examined in this study contained sufficient antemortem information to permit identification. This is a reflection of the nature of the treatment provided to edentulous individuals; i.e., provision of complete dentures which usually require little in the way of diagnostic investigation (8). The presence of radiographs in 37% of the individuals may appear to contradict this finding; if an antemortem radiograph is present, a postmortem radiograph could be compared? However, the vast majority of these radiographs were DPT views (see Fig. 1) that demonstrate the mandibular and maxillary arches as well as some skeletal features. However, skeletal landmarks can be difficult to properly assess on tomographs and the presence of resorption of bone from both arches means that unless such films are taken within several months of each other, interpretation can be near impossible (9). Clearly if such DPT films demonstrate pathologies of other kinds, they may be helpful in the identification effort. However, the acquisition of DPT films postmortem is highly problematic due to the nature of the tomographic process and the expense of the equipment.

The presence of lateral skull films in the records is helpful. Such films display numerous skeletal features and are easily replicated postmortem. If the radiographs have been taken using a cephalostat, a geometry stabilising system, then it may be possible to accurately reposition a postmortem film to enable even greater accuracy during the comparison process; see Fig. 4. However, it should be noted that the lateral skull films in all but one case were taken before the provision of dental implants (10). The presence of

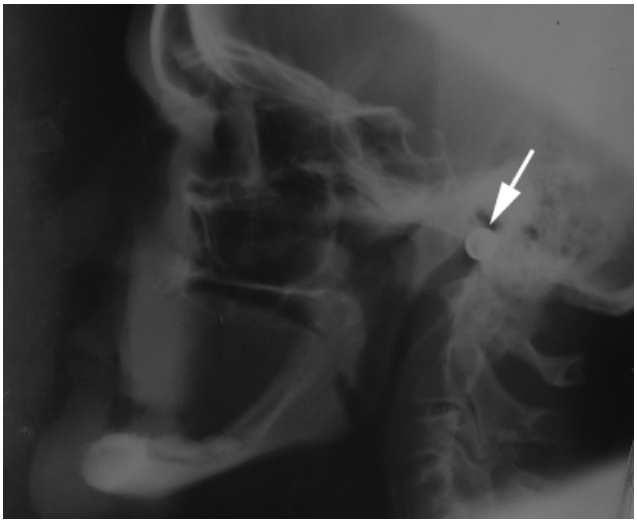

FIG. 4—*Example of a lateral cephalometric film. Note the head location piece arrowed; this ensures accurate repositioning should the patient require further radiographic views and may of use in postmortem film acquisition.*

implants greatly simplifies the identification process and therefore such radiographs may be of less importance (3). The presence and unique nature of the air sinus spaces visible on these radiographs may also be of use (11–13).

It is interesting to note that none of the records examined in this study made any reference to denture labeling (14). One can therefore assume that all these dentures were unlabeled. A number of authors of both scientific papers and of reports following natural and man made disasters have recommended that denture marking is undertaken routinely, although this is often not the case (8,14–17). Further research is required to determine the barriers to the placement of the markings on dentures and whether or not the reluctance to undertake these procedures is sourced from the dental professional or the patient. It should be noted that a number of countries, and several states within the U.S. require identifying marks to be placed on dentures. There is no published evidence on the compliance with these procedures.

Furthermore, the inclusion of serial numbers on dental implants would be of immense value in cases of mass disaster, however, as to date, only a simple batch and/or lot number is included on the packaging of such a device (Fig. 3) This practice is similar to that used in the manufacturing of orthopedic metallic fixation appliances in that, information contained on such items pertain only to a simple lot number indicating the time of production of the item together with its release date for availability to practitioners; hence, it provides no functional information that may be used to track back to the end-user (18).

A number of additional techniques for the identification of edentulous individuals have been described. These include the use of the palatal rugae; indentations are often visible on the fitting surface of maxillary dentures and these can be compared, using high definition impression materials, to the deceased (6,19,20). One study found 79% accuracy when rugae tracings from dental casts were evaluated and this increased to 100% when the topography of the entire cast was assessed. Authors have developed the technique by using computerized recording and comparison (21). However, such techniques rely upon the palatal tissues being in good condition postmortem. In cases of decomposition or individuals who have been burnt it is often impossible to take impressions of sufficient quality due to the friability of the tissues and the technique is obviously of no value in skeletal remains (6).

A more obscure technique is the use of alveolar nutrient canals visible on the radiographs of edentulous individuals. Such canals supply the neurovascular elements to the teeth and persist in the edentulous jaws, being most visible on the mandible. However, assessment of these tiny structures requires radiographs of high quality and only a single case report exists in the literature (22).

It is also clear that further investigation is required in order to establish the ability of forensic odontologists to identify individuals from DPT films of edentulous jaws and assess the time frame between after which such films are no longer of forensic value. One study has examined the use of high quality radiographs of the maxilla, and found that experienced forensic dentists could identify all 20 cases; but the materials were of the highest quality and did not employ authentic forensic materials (23). By establishing the poor potential for such individuals to be identified using dental techniques, and thus the need to engage potentially more time consuming and expensive means of identification, may enforce the need for effective denture labeling to be undertaken routinely.

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